

## Detecting metrologically useful multipartite entanglement

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In the first part of the talk, we discuss multipartite entanglement detection in cold gases. After revising the literature, we present our results concerning detection of multipartite entanglement close to Dicke states, connected to an experiment with Bose-Einstein condensates [1]. It was possible to detect multipartite entanglement of up to 28 particles with collective measurements.

In the second part of the talk, we look for methods to detect quantum states that are not only entangled, but are also useful for metrology (see [2] for a review). We will present an approach that can detect metrologically useful entanglement in the Dicke state experiments mentioned above [3]. Finally, we introduce a general method that can detect metrologically useful entanglement based on the measurement of a couple of observables, and can be used in a number of experimental setups.

[1] B. Lücke, J. Peise, G. Vitagliano, J. Arlt, L. Santos, G. Tóth, and C. Klempt, Detecting multiparticle entanglement of Dicke states, *Phys. Rev. Lett.* 112, 155304 (2014), see also [physics.aps.org](http://physics.aps.org).

[2] G. Tóth and I. Apellaniz, Quantum metrology from a quantum information science perspective, *J. Phys. A: Math. Theor.* 47, 424006 (2014), special issue "50 years of Bell's theorem"

[3] I. Apellaniz, B. Lücke, J. Peise, C. Klempt, and G. Tóth, Detecting metrologically useful entanglement in the vicinity of Dicke states, *New J. Phys.* 17, 083027 (2015).